




MEMORANDUM

TO: New Hampshire Dioxane Contamination Site File

cc: John McKeown, On-Scene Coordinator (OSC), U.S. Environmental Protection Agency (EPA) Region I, Emergency Planning and Response Branch (EPRB)

Mike Nalipinski, OSC, U.S. EPA Region 1, ERPB

FROM: John F. Kelly, Project Leader, Licensed Professional Geologist (LPG), Weston Solutions, Inc. (WESTON®), Superfund Technical Assessment and Response Team III (START) 

THRU: George Mavris, Project Leader, LPG, (START)

DATE: 2 May 2013

RE: Review and Findings of Available Geologic/Hydrologic Information, New Hampshire Dioxane Contamination Site, Atkinson, Rockingham County, New Hampshire. TDD Number (No.) 01-12-04-0010; Task No. 0794; Document Control (DC) No. R-7420.

INTRODUCTION

On 18 April 2013, Weston Solutions, Inc. (WESTON®), Superfund Technical Assessment and Response Team III (START) was requested by U.S. Environmental Protection Agency (EPA) Region I, Emergency Planning and Response Branch (EPRB), On-Scene Coordinator (OSC) John McKeown to review the available file information, including the files associated with the New Hampshire Dioxane Contamination Site (the site) and determine if there was a potential for the 1,4-Dioxane contamination detected in residential drinking water wells located in the area of the intersection of Emery Drive and Belknap Drive, Atkinson, Rockingham County, New Hampshire, to have possibly originated from nearby industrial sources in the general vicinity. To make this determination, START reviewed the limited available references listed in Attachment A, References Reviewed. Information included geologic data and reports, as well as site-specific and general hazardous waste site investigation reports in the area of the site, but did not generally include documents such as bedrock boring logs, pump test data, subsurface fracture analysis data, or bedrock surface contour maps.

Contaminant of Concern (1,4-Dioxane) Characteristics

Synonyms for 1,4-Dioxane (C₄H₈O₂, CAS No. 123-91-1) include Dioxane, Dioxan, p-Dioxane, Diethylene Dioxide, Diethylene oxide, Diethylene ether, or Glycol ethylene ether. 1,4-Dioxane is used primarily as a solvent in paints, varnishes, lacquers, cosmetics, deodorants, cleaning and detergent preparations, and in scintillating fluids. 1,4-Dioxane often has been used with



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chlorinated solvents, particularly 1,1,1-trichloroethane (TCA), as a stabilizer and corrosion inhibitor.

When 1,4-Dioxane is used as a solvent stabilizer, the solvent itself is regulated as hazardous waste. When applied as an additive, 1,4-Dioxane is not used for its solvent properties and does not meet the regulatory definition of a solvent. 1,4-Dioxane generally is listed with a group of pollutants in state and federal guidance for air pollution control and release reporting and in water pollutant control and National Pollutant Discharge Elimination System (NPDES) permitting.

1,4-Dioxane is highly flammable and potentially explosive if not stored properly. The chemical is a cyclic ether that is highly miscible in water; in fact, it mixes with water so readily that it can be found in groundwater plumes far in advance of any solvents with which it might have entered the subsurface originally. It also migrates rapidly in soil. 1,4-Dioxane contamination often can be found in association with releases of chlorinated solvents.

1,4-Dioxane is typically found at solvent release sites and at polyethylene terephthalate (PET) plastic sites. 1,4-Dioxane may impact the environment in different ways once released. It is short-lived in the atmosphere, with a 6- to 10-hour half-life. Once released into soil, it moves rapidly from soil to groundwater as it is weakly retarded by sorption to soil particles. 1,4-Dioxane migrates rapidly in groundwater and is relatively resistant to biodegradation.

According to the 1995 U.S. EPA, Office of Pollution Prevention and Toxics (OPPT) Chemical Fact Sheet and the 2009 U.S. EPA, Federal Facilities Restoration and Reuse Office Emerging Contaminant 1,4-Dioxane Fact Sheet, EPA 505-F-11-004; EPA has listed 1,4-Dioxane as a probable human carcinogen based on the results of animal studies, but little information is available on the long-term effects of 1,4-Dioxane on human health.

SITE DESCRIPTION

The site is located in a residential area in the vicinity of Emery Drive, Belknap Drive, Brookside Terrace, Island Pond Road, Oak Ridge Drive, and Deer Run Road in Atkinson, Rockingham County, New Hampshire (see Attachment B, Figures 1 and 2). The geographic coordinates, as measured from the approximate intersection of Emery and Belknap Drives, are 42° 50' 57" north latitude and 71° 11' 15.5" west longitude.

Several areas of industrial facilities are located within a 1-mile radius of the intersection of Emery and Belknap Drives. These include, but are not limited to, areas along Industrial Way, Commerce Drive, NH State Route 111, NH State Route 121, and Gigante Drive within the towns of Atkinson and Hampstead, New Hampshire (see Attachment B, Figure 3).



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SITE BACKGROUND

In October 2002, New Hampshire Department of Environmental Services (NH DES) received drinking water analytical results from a residential well sample that indicated volatile organic compounds (VOCs) above NH DES Ambient Groundwater Quality Standards (AGQS). The VOCs that exceeded the NH DES AGQS included the following (with the respective standard in parentheses): methyl tert butyl ether [13 micrograms per Liter ($\mu\text{g/L}$)] and 1,1-dichloroethene (7 $\mu\text{g/L}$).

In 2003, NH DES conducted drinking water sampling and identified three additional residential wells that had been impacted. Point-of-Entry (POE) treatment systems were installed at four residences. NH DES continues to maintain the POEs at these residences.

During November/December 2011, NH DES collected drinking water samples from all of the residences with POE systems and analyzed these samples for 1,4-Dioxane. NH DES conducted this additional analysis because 1,4-Dioxane is considered to be an “emerging contaminant” that requires a separate analysis for detection at low concentrations. All four systems were sampled following treatment, and each system revealed levels of 1,4-Dioxane that exceeded both the NH DES AGQS and Drinking Water Standard of 3 $\mu\text{g/L}$.

In December 2011, NH DES began analyzing adjacent residential wells and a larger geographic area based on the results obtained from the wells with POE systems. These samples were analyzed for VOCs and 1,4-Dioxane by the NH Public Health Laboratory. From December 2011 to April 2013, water from 17 residential wells exceeded the NH DES AGQS for 1,4-Dioxane and an additional 30 residential wells had detectable levels.

Analytical results of groundwater samples indicated that 1,4-Dioxane was detected above the NH DES AGQS in several private drinking water wells (see Attachment B, Figure 4). Ongoing investigations, conducted by NH DES, have not identified the source of groundwater contamination. NH DES continues to be involved with investigations to determine the source and extent of the contamination.

Geologic and Hydrologic Setting

According to the mapping of the surficial geology of New Hampshire by Goldthwait, Goldthwait, and Goldthwait (1951), the area within the vicinity of the intersection of Emery and Belknap Drives consists of ground moraine glacial till of Pleistocene age. The Surficial Geologic Map of the New Hampshire Part of the Salem Depot Quadrangle, New Hampshire and Massachusetts, Rockingham County, NH by Goldsmith (1991) indicates that the area within 1-radial mile of the intersection of Emery and Belknap Drives consist of poorly to non-sorted till mixture ranging in size from clay to large boulders, but dominated by silt to pebble size



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materials. Goldsmith noted this deposit to consist of materials deposited directly by the ice sheet, with little to no modification by meltwater. In some places, the deposits mantle bedrock thinly (with about 10 feet) or discontinuously. Goldsmith also mapped several freshwater swamps within 1-radial mile of the intersection of Emery and Belknap Drives. These swamp deposits consist of muck, peat, silt, and sand underlying poorly drained lowland areas. Review of the Water Well Reports for wells in the vicinity of the site indicate that surficial deposits are thin, often less than 5 feet thick. Cussing & Jammallo Inc. (C&J) noted during a 2002 investigation of a facility approximately 0.7 miles to the north-northeast of the site that a relatively thin surficial deposit overlaid bedrock and that bedrock outcrops were found on the property of concern being examined. Surficial deposits encountered by C&J in wells installed on the property of concern were consistent with the deposits mapped for the area by Goldsmith.

According to the U.S. Geological Survey (USGS) Geohydrologic, GroundWater Quality, and Streamflow Data for the Stratified-Drift Aquifers in the Lower Merrimack and Coastal River Basins, Southeastern New Hampshire; Open-File Report 89-390, the site and the entire area within a 1-mile radius of the site are within the same till-bedrock aquifer. The regional surface water drains south along the Hog Hill Brook.

The site is located within an area generally underlain by bedrock comprised of the Silurian- to Ordovician-aged Metasedimentary and Metavolcanic Rocks of the Merrimack Trough. The area of the site is underlain by Berwick Formation of the Merrimack Group (SOB), which is described as a purple biotite-quartz-feldspar granofels or schist and interbeds of calc-silicate granofels and minor metapelites. A relatively small intrusive unit (D1b) has been mapped in the north-northwestern portion of the 1-mile radius of the intersection of Emery and Belknap Drives near NH State Route 111. This pink, equigranular, biotite granite intrusion is noted to be a Plutonic and Associated Volcanic Rocks New Hampshire Plutonic Suite of Late to Early Devonian age. A second relatively small intrusive unit (D1m) has been mapped in the north-northeastern portion of the 1-mile radius of the intersection of Emery and Belknap Drives north and east of NH State Routes 111 and 121. This two-mica granite intrusion is noted to be a Plutonic and Associated Volcanic Rocks New Hampshire Plutonic Suite of Late to Early Devonian age and is similar to the Concord Granite.

No major structural features, such as faults, have been mapped in the area of the site. The Misery Hill Fault is located approximately 3 miles to the east of the intersection of Emery and Belknap Drives. This high angle fault trends N20E to N40E and dips to the west.

According to Sundeen (1971), the most common joint set in the metasedimentary rocks of this area is nearly vertical and strikes normal to the regional foliation. Sundeen noted the regional foliation as striking or trending approximately N45°. In 2002, C&J conducted measurements of the orientation (strike and dip) of some joints/fractures observed on the bedrock outcrops located on the facility along NH State Route 111 and surmised that the inclination (dip) and trend (strike)



of the majority of the joints measured were similar to Sundeen's description. Additional map information provided by NH DES for outcrops within 5,000 feet of the site indicate bedrock lineaments primarily striking or trending to the northeast direction, with a second group striking or trending to the northwest direction (see Attachment B, Figures 5 and 6). It should be noted that the correlation of topographic lineaments may reflect the bedrock fracture fabric and/or the underlying fractures controlling groundwater movement.

Limited information is available regarding the groundwater flow in the area of the site and surrounding area. Potable water supplies are generally obtained from bedrock wells in the area of the site and within a 1-mile radius of the site. Water Well Records for this area indicate that supply wells are often drilled to depths in excess of 200 feet, and that bedrock is encountered at shallow depths (on occasion less than 5 feet), but well logs were not available for these residential supply wells. Monitoring wells installed or examined by C&J for an investigation of a facility approximately 0.7 miles north-northeast of the intersection of Emery and Belknap Drives indicate that overburden groundwater flow is interpreted to be generally to the southwest across the Facility towards a low detention basin along Route 111. The C&J 2002 report indicates that groundwater flow in the upper bedrock system at the facility being investigated has a radial flow from a topographic high, and groundwater flows to the southwest and northeast on the facility. C&J 2002 stated that groundwater on the facility is interpreted to be primarily in the bedrock. C&J (2002) also stated that the principle groundwater transport in the bedrock system is likely along fractures/joints, etc. However, due to the limited available data regarding fracture patterns beneath the study area, it appears possible that groundwater flows within the bedrock fractures which may trend along similar strikes to the regional foliation.

The "Bi-Annual April 2008 Groundwater Sampling and Analysis Round Data Report", prepared for a facility located 0.7 miles north-northeast of the site, noted that in samples collected in April 2008, 1,4-Dioxane was noted in bedrock monitoring well ATC-2 exceeding its respective NH DES AGQS. HTE Northeast, Inc., noted in 2012 that the presence of 1,4-Dioxane in one overburden well [CJ-4S (1.7 µg/L)] and in several bedrock wells [CJ-4D (3.4 µg/L), CJ-6 (0.78 µg/L), ATC-2 (182 µg/L), WSW-1 (7.3 µg/L) and WSW-2 (3.1 µg/L)] is likely a result of one of its many uses as a stabilizer and corrosion inhibitor with chlorinated solvents, particularly 1,1,1-TCA.

SUMMARY

The New Hampshire Dioxane Contamination Site (the site) consists of residential properties located in the vicinity of Emery Drive, Belknap Drive, Brookside Terrace, Island Pond Road, Oak Ridge Drive, and Deer Run Road, Atkinson, Rockingham County, New Hampshire (NH), whose private drinking water wells have been impacted with 1,4-Dioxane. The site is currently considered to be geographically centered near the intersection of Emery and Belknap Drives, Atkinson, NH.



The Contaminant of Concern, 1,4-Dioxane, has often has been used with chlorinated solvents, particularly 1,1,1-trichloroethane (TCA), as a stabilizer and corrosion inhibitor. There are several industrial facilities located within a one-mile radius of the site which have been reported to utilize, potentially utilize, or have been found to contain detectable levels of chlorinated solvents, including TCA, at their facility. These include facilities along Gigante Drive and NH State Route 121 (located to the northeast), NH State Route 111 (located to the north and west), Commerce Drive (located to the northwest), and Industrial Way (located to the west-southwest). Releases of chlorinated solvents have also been documented in some of these areas. Additional facilities which may have utilized chlorinated solvents and/or potentially utilized 1,4-Dioxane may exist in the vicinity but have not currently been identified.

Based on the limited data available for review, as noted above, groundwater in the vicinity of the site is believed to flow primarily in the bedrock aquifer. However, groundwater is also suggested to generally flow in a southeasterly direction in overburden materials. Groundwater flow in the bedrock aquifer is most likely controlled by fractures/joints. The regional surface water drains south along the Hog Hill Brook. Drinking water analytical results from residential wells located in the same vicinity (along the same road, next to, or near each other) and at similar depths show no consistent pattern of groundwater contamination, i.e., drinking water results from a well may show concentrations of 1,4-Dioxane above NH DES AGQS, while drinking water results from an adjacent residence may show non-detected results. This may be a result of groundwater flowing in different, unconnected fractures although trending along similar strikes. However, due to the limited available data regarding fracture patterns beneath the study area, at this time it is not possible to precisely determine groundwater flow within the fractured bedrock aquifer system.

Several industrial facilities are located along these presumed trends from the site and may be the potential source of the 1,4-Dioxane contamination detected at the New Hampshire Dioxane Contamination site. However, due to the limited site- and area-specific hydrologic and geologic data available at this time, it appears that further work is needed to identify the potential source(s); but it is likely that the industrials facilities located within the 1-mile radius to the north, northeast, and northwest may be potential sources of the 1,4-Dioxane contamination.

Attachments

Attachment A

References Reviewed

REFERENCES REVIEWED

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- [2] Billings, M. The New Hampshire State Planning and Development Commission. *The Geology of New Hampshire, Part II – Bedrock Geology*. 1986.
- [3] Cushing & Jammallo, Inc., *Site Investigation Report, Johnson & Johnston Associates, Inc., 130 Route 111, Hampstead, New Hampshire, NHDES# 200001038*, prepared for Johnson & Johnston Associates. 12 December 2000.
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- [5] Goldthwait, J.W., Goldthwait, L., and Goldthwait, R.P., 1951, The Geology of New Hampshire, Part I, Surficial Geology. Geo-NHX-250000-SMAP. Link: <http://des.nh.gov/organization/commissioner/pip/publications/geologic/geology.htm>
- [6] Goldsmith, Richard, *Surficial Geologic Map of the New Hampshire Part of the Salem Depot Quadrangle, New Hampshire and Massachusetts, Rockingham County, New Hampshire*. Prepared in cooperation with the U.S. Geological Survey. 1991.
- [7] Hornok, G. Weston Solutions, Inc. (START). 2013. Figure 1, New Hampshire Dioxane Contamination, Emery and Belknap Drives, Atkinson, New Hampshire, TDD No. 12-04-0010. 1 May.
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- [9] HTE Northeast, Inc., *2011 Periodic Summary Report and October 2011 Data Submittal, Former Johnson & Johnston Facility, 130 Route 111, Hampstead, NH, NHDES Site #: 200001038*, prepared for Winfield Alloy, Inc. 9 January 2012.
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- [11] HTE Northeast, Inc., *January 2012 Data Submittal, Former Johnson & Johnston Facility, 130 Route 111, Hampstead, NH*, NHDES Site #: 200001038, prepared for Winfield Alloy, Inc. 23 February 2013.
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- [13] New Hampshire Department of Environmental Services, John Regan, Atkinson, NH, Emery Drive Site, *Bedrock Map with Bedrock Lineaments*. 19 April 2013.
- [14] New Hampshire Department of Environmental Services, John Regan, Atkinson, NH, Emery Drive Site, *LIDAR Data Map*. 19 April 2013.
- [15] New Hampshire Department of Environmental Services, Waste Management Division. 2011. *Environmental Fact Sheet – 1,4-Dioxane and Drinking Water*.
- [16] New Hampshire Department of Environmental Services. 2013. One Stop – Search Results, RE: Atkinson, NH. Printout dated 1 May.
- [17] New Hampshire Department of Environmental Services. 2013. One Stop – Search Results, RE: Hampstead, NH. Printout dated 1 May.
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- [19] New Hampshire Department of Safety, Hazardous Materials Unit, *Incident Report*. RE: Fire on January 27, 1990 at the Johnson & Johnston Facility, Route 111, Hampstead, New Hampshire. 27 January 1990.
- [20] Service Chemical Corp., Susan L. Prior, Compliance Director, *Incident Report*. RE: Release of 18 – 20 gallons of 1,1,1-Trichloroethane on 16 October 1989. 16 October 1989.
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- [22] Sundeen, D. A, Bedrock Geology of the Haverhill 15' Quadrangle, New Hampshire. Bulletin No 5. Geo-057-062500-BBBM (Formerly Geo76). Prepared in cooperation with the U.S. Geological Survey. 1971.
- [23] U.S. Environmental Protection Agency. 2013. Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) Superfund Program, Region I, RE: Atkinson, NH sites. Printout dated 1 May.
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- [28] U.S. Environmental Protection Agency. 2013. Resource Conservation Act Information System (RCRA Info), RE: Hampstead, NH sites. Printout dated 1 May.
- [29] U.S. Geological Survey, Bedrock Map Data, Emery Drive, Data Series 215, New Hampshire Geological Survey Bedrock Map of New Hampshire. 2006.
- [30] U.S. Geological Survey, Peter J. Stekl and Sarah M. Flanagan, Water Resources Division, Bow, New Hampshire, *Geohydrology and Water Quality of Stratified-Drift Aquifers in the Lower Merrimack and Coastal River Basins, Southeastern New Hampshire*. Open File Report 91-4025. 1992.
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Attachment B

Figure 1	Site Location Map – New Hampshire Dioxane Contamination Site
Figure 2	Site Diagram – New Hampshire Dioxane Contamination Site
Figure 3	Areas of Industrial Facilities Within A One-Mile Radius of the Site
Figure 4	NH DES Atkinson, 1,4-Dioxane Survey
Figure 5	NH DES Atkinson, NH Emery Drive Site Lineament Map
Figure 6	NH DES Atkinson, NH Emery Drive Site LIDAR Map

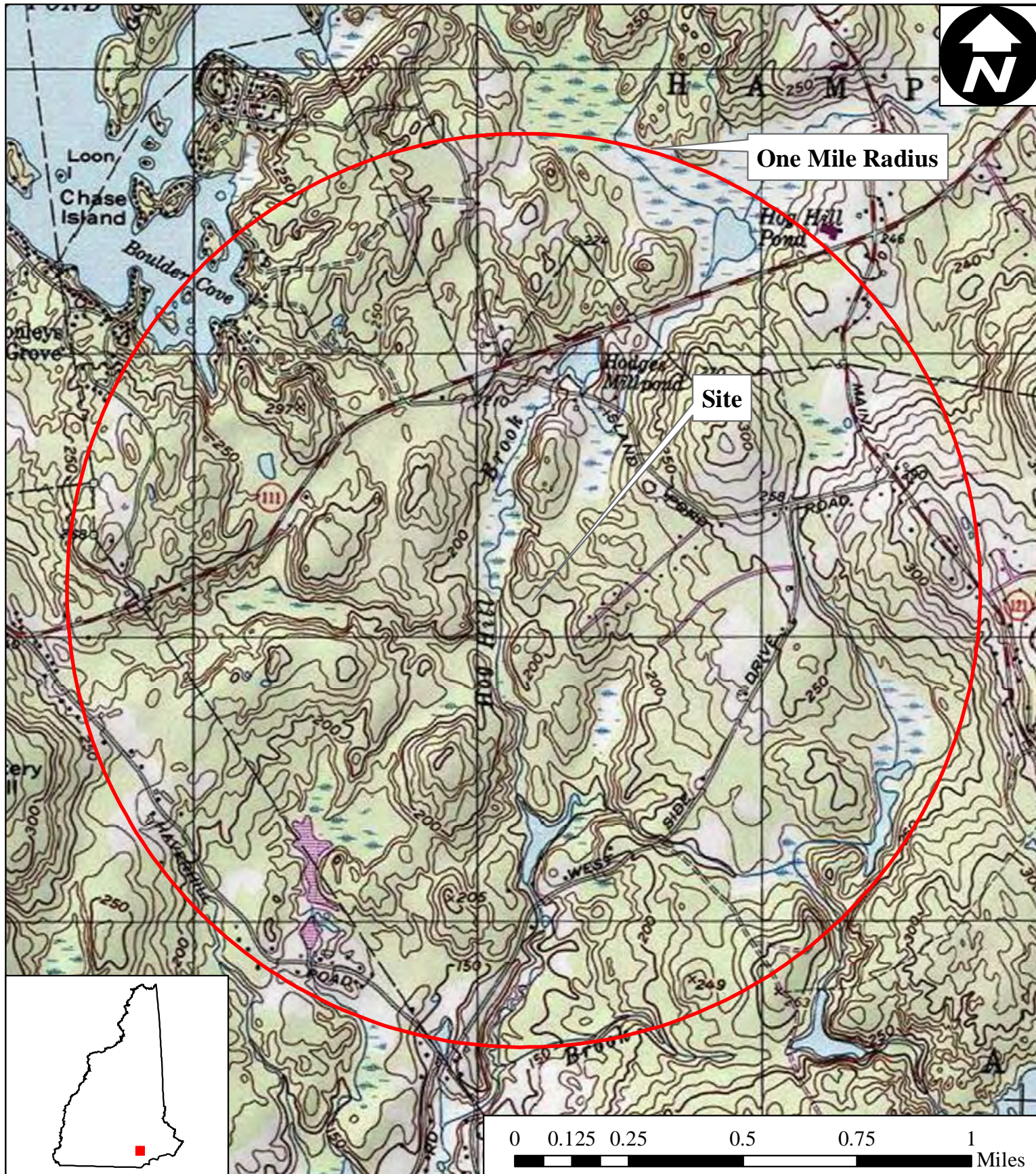


Figure 1

Site Location Map

**New Hampshire Dioxane Contamination
Emory and Belknap Drives
Atkinson, New Hampshire**

**EPA Region I
Superfund Technical Assessment and
Response Team (START) III
Contract No. EP-W-05-042**

TDD Number: 12-04-0010
Created by: B. Mace
Created on: 26 June 2012
Modified by: G. Hornok
Modified on: 1 May 2013

Data Sources:

Topos: MicroPath/USGS
Quadrangle Name(s): Derry, NH
All other data: START



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Figure 2
Site Diagram


New Hampshire
Dioxane Contamination
Emory and Belknap Drives
Atkinson, New Hampshire

EPA Region I
Superfund Technical Assessment and
Response Team (START) III
Contract No. EP-W-05-042
TDD Number: 12-04-0010
Created by: B. Mace
Created on: 26 June 2012
Modified by:
Modified on:

Legend

 Streets



0 0.125 0.25
 Miles

0 900 1,800
 Feet

Data Sources:

Imagery: Bing Maps Aerial (Microsoft Corp)
Topos: MicroPath
All other data: START



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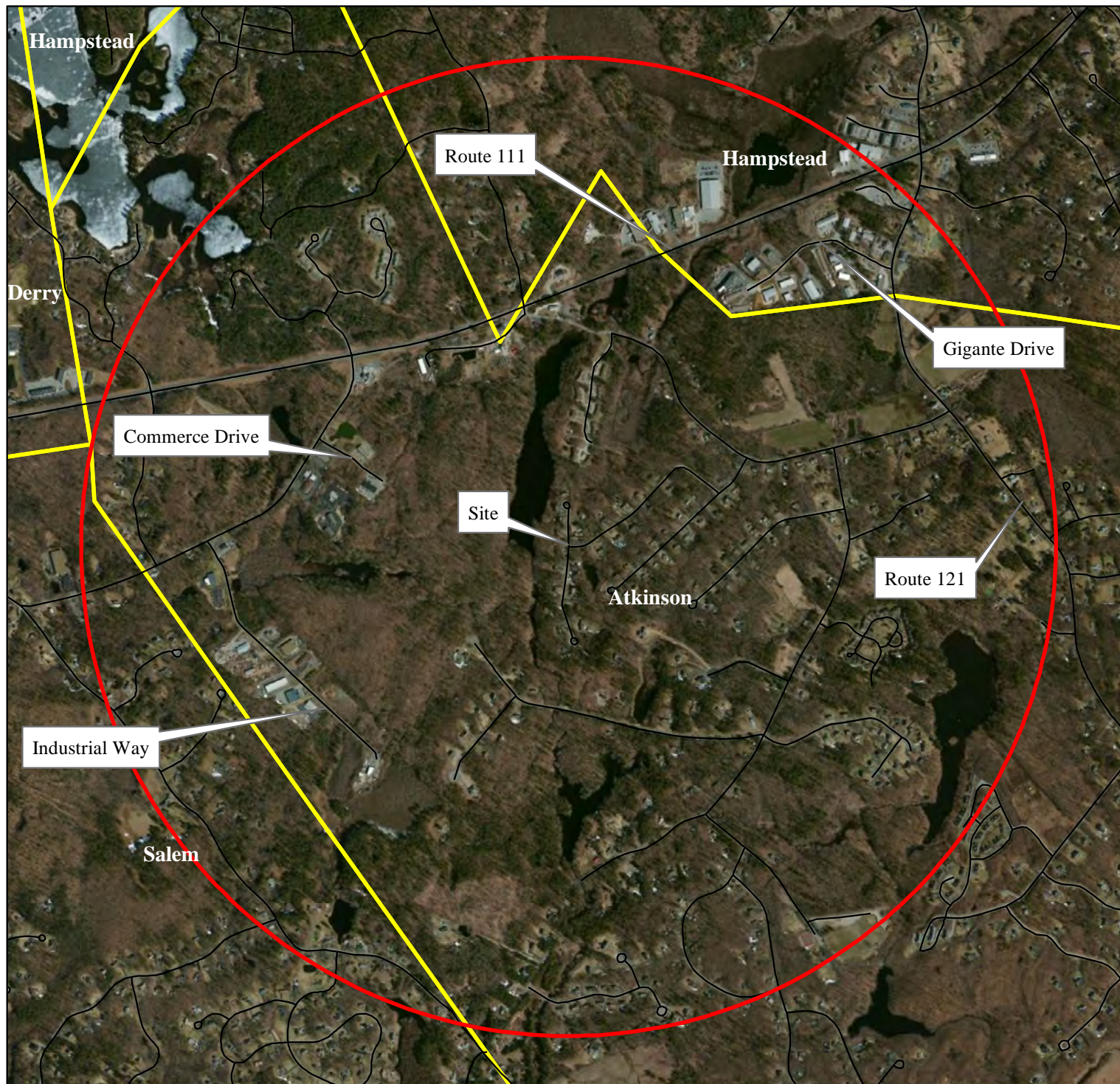
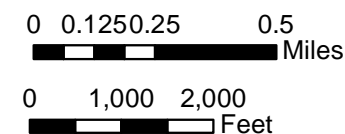


Figure 3
Areas of Industrial Facilities
within 1-Mile Radius
New Hampshire
Dioxane Contamination
Emory and Belknap Drives
Atkinson, New Hampshire

EPA Region I
 Superfund Technical Assessment and
 Response Team (START) III
 Contract No. EP-W-05-042
 TDD Number: 12-04-0010
 Created by: B. Mace
 Created on: 26 June 2012
 Modified by: G. Hornok
 Modified on: 1 May 2013

Legend

- 1-Mile Radius
- Road
- Town Boundary



Data Sources:
 Imagery: Bing Maps Aerial (Microsoft Corp)
 Topos: MicroPath
 All other data: START

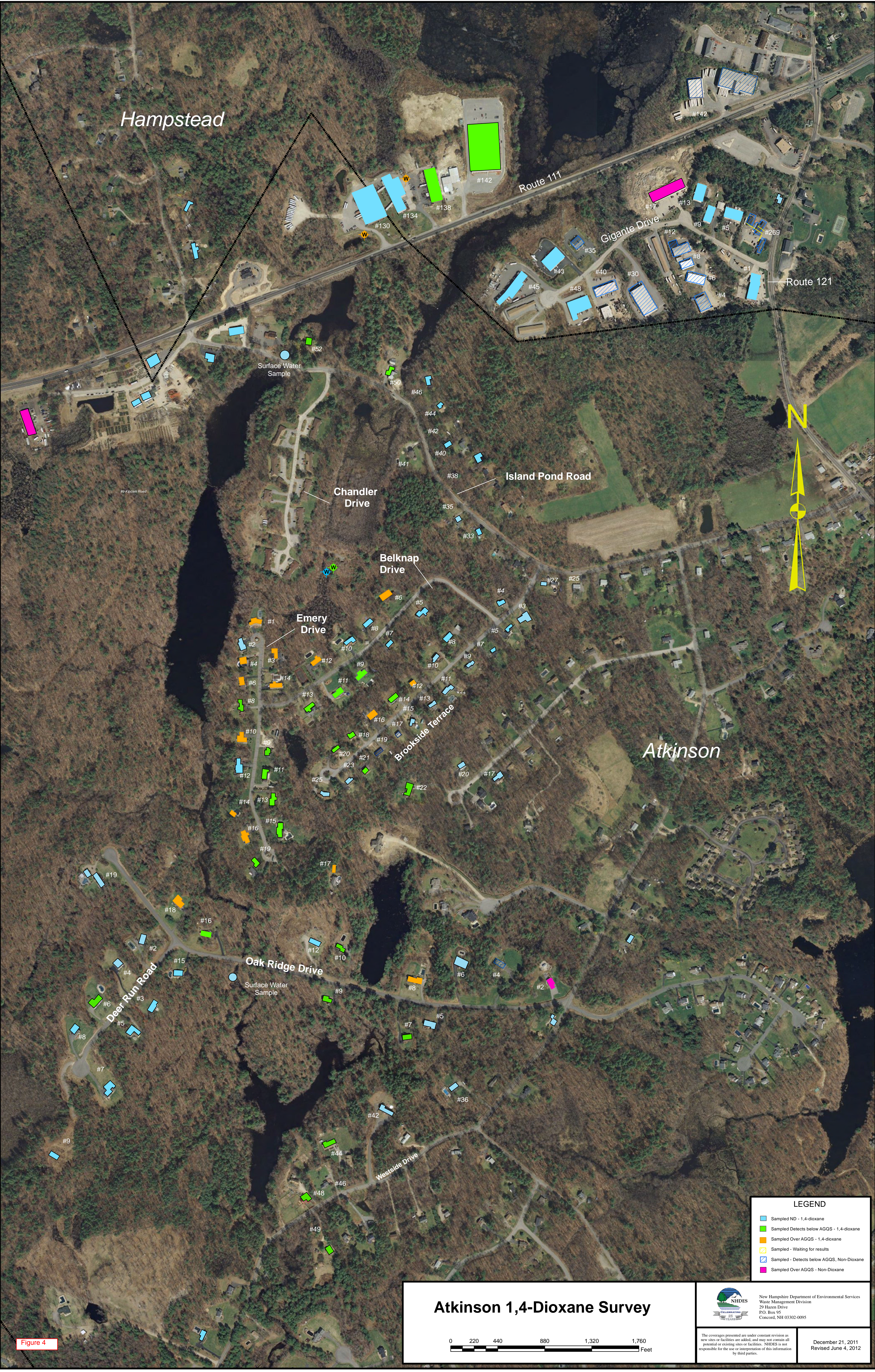


Figure 4

Atkinson 1,4-Dioxane Survey

0 220 440 880 1,320 1,760 Feet



New Hampshire Department of Environmental Services
Waste Management Division
29 Hazen Drive
P.O. Box 95
Concord, NH 03302-0095

The coverages presented are under constant revision as new sites or facilities are added, and may not contain all potential or existing sites or facilities. NHDES is not responsible for the use or interpretation of this information by third parties.

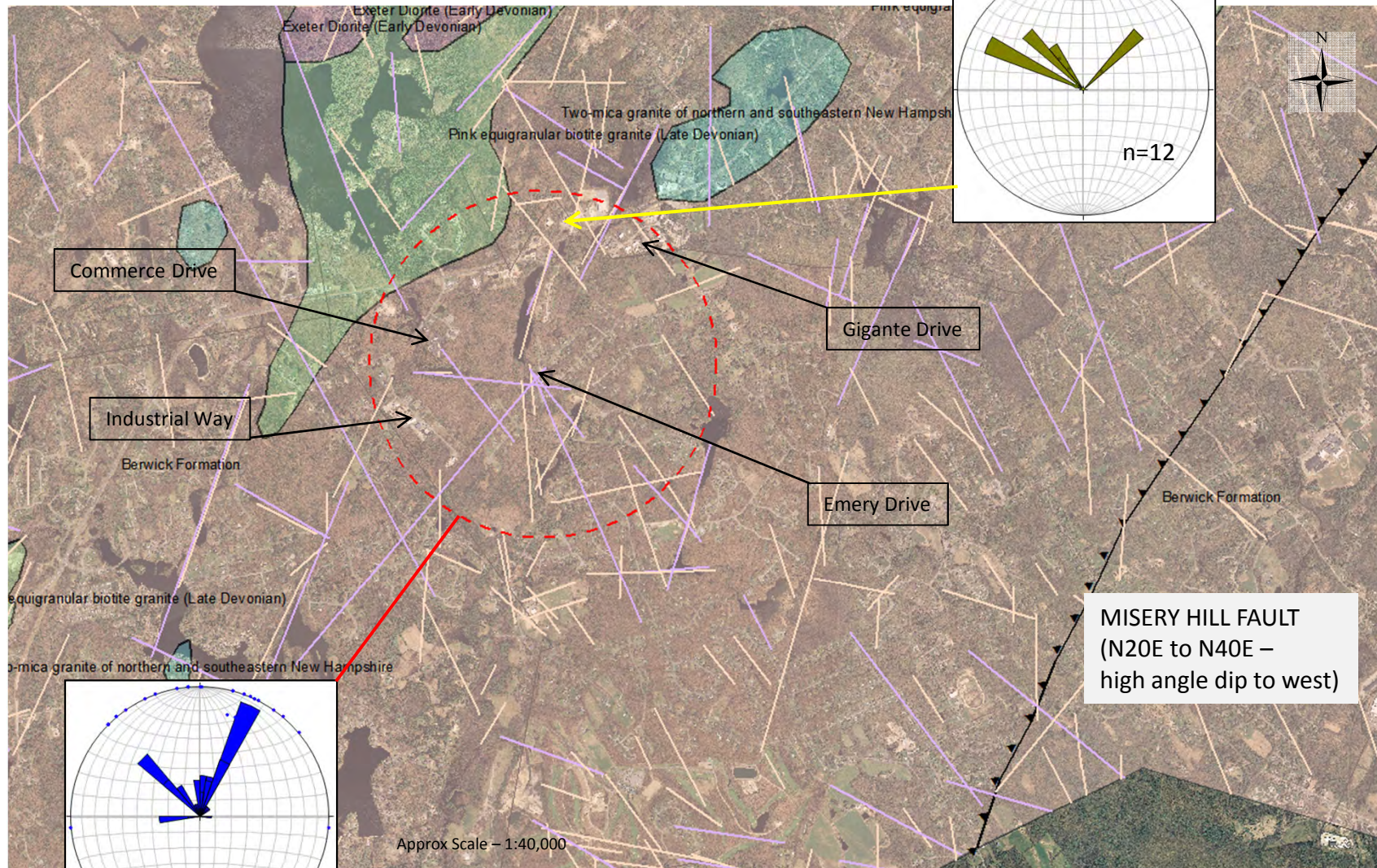
December 21, 2011
Revised June 4, 2012

Atkinson, NH

Emery Drive Site

(site in center of red circle)

Johnson & Johnston Facility on trend of about N5E to N15E of site



Data Sources:

Bedrock – Bedrock Geologic Map of NH (Lyons, et al)

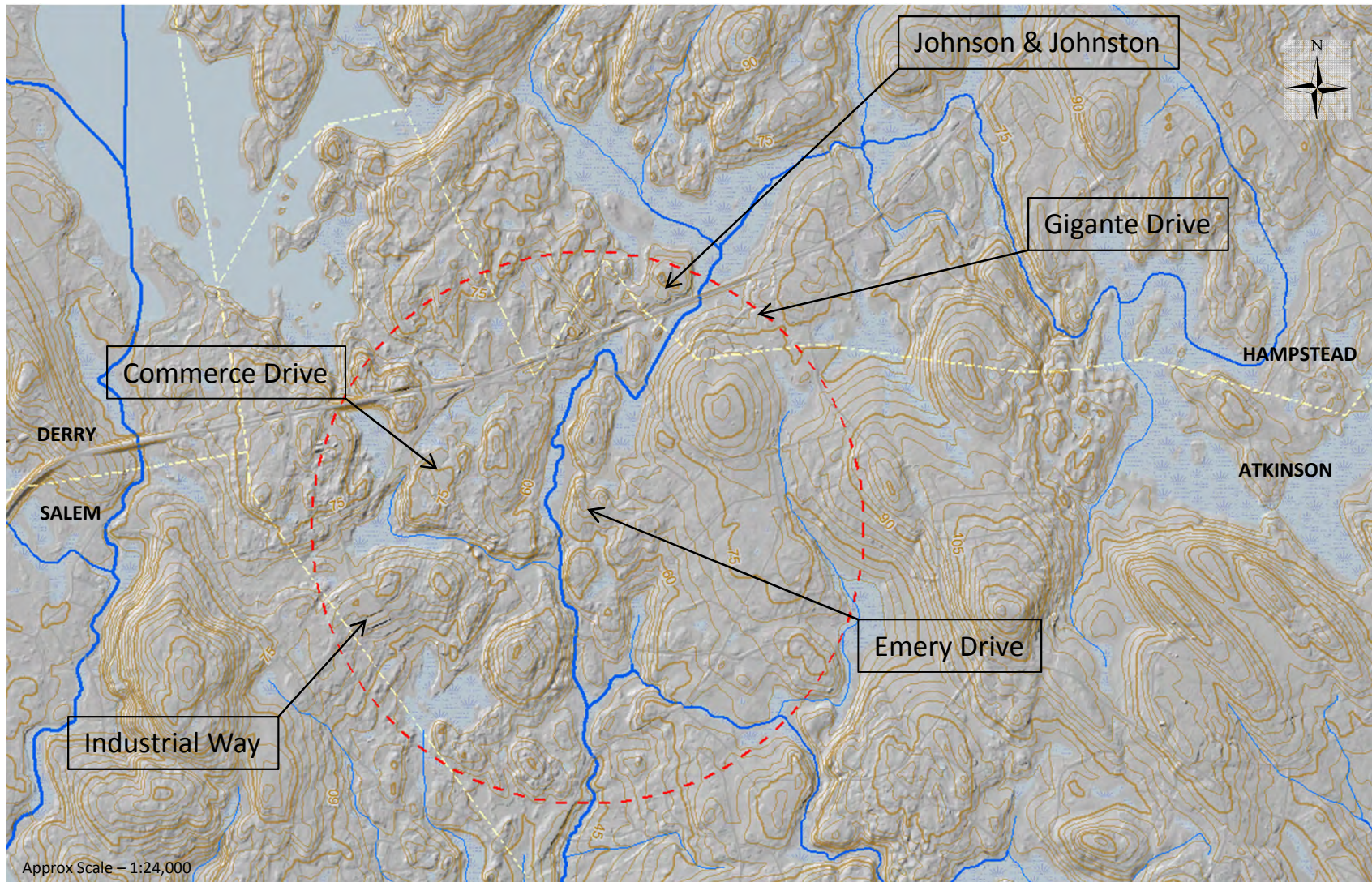
Bedrock Lineaments (1:20K,80K) – Lineament Map (area 1) of NH bedrock aquifer assessment (USGS-DOI)

Facility Bedrock Features – Johnson & Johnston GMP supporting documentation (Cushing, et al, 2002)

Date : 4/19/13

Figure 5

Atkinson, NH
Emery Drive Site
(site in center of red circle)



NOTES

1. Data Sources:
 - LIDAR Data (Hillshade) – CSRI : NHGranit
 - Topo Contours –USGS & CSRI:NHGranit
 - Hydrography – NHGS/NHDES
2. Elevation unit is meters, Contour Interval = 3 meters

Date : 4/29/13

Figure 6